Announcements

- 1st EXAM on *Tuesday, Feb. 14!*
- Homework for tomorrow…

  Ch. 28: CQ 9, Probs. 26, 30, & 38

  CQ3: a) increases, negative PE becomes less negative b) less than, as PE increases, KE decreases
  28.12: 11V
  28.37: 0.49 m/s

Office hours…

MW 10-11 am
TR 9-10 am
F 12-1 pm

- Tutorial Learning Center (TLC) hours:

  MTWR 8-6 pm
  F 8-11 am, 2-5 pm
  Su 1-5 pm

Chapter 28

The Electric Potential

(*The Electric Potential of Many Charges*)

Last time…

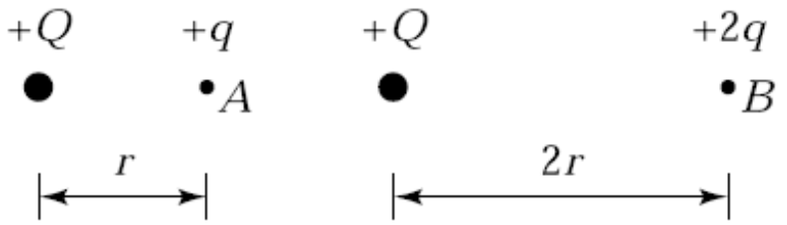
Electric Potential of a point charge..

$$V = \frac{Kq}{r}$$

Quiz Question 1

Two test charges are brought separately into the vicinity of charge $+Q$. First, charge $+q$ is brought to point A a distance r from $+Q$. Next, $+q$ is removed and a charge $+2q$ is brought to point B a distance $2r$ from $+Q$.

Compared with the *electric potential* of $+Q$ at A, that of $+Q$ at B is



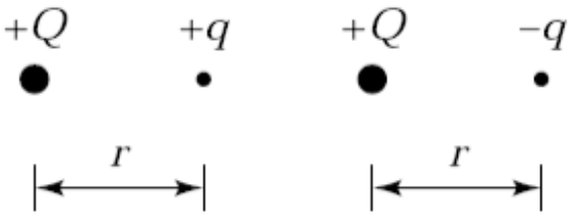
1. greater.
2. smaller.
3. the same.

$$V = \frac{KQ}{r}$$

Quiz Question 2

Two test charges are brought separately into the vicinity of charge $+Q$. First, charge $+q$ is brought to a point a distance r from $+Q$. This charge is removed and a charge $-q$ is brought to the same point.

The *electric potential energy* of which charge ensemble is *greater*:



1. $+Q$ & $+q$
2. $+Q$ & $-q$
3. It is the same for both.

28.7: The Electric Potential of Many Charges

The *Electric Potential* at a point in space is the sum of the potentials due to each charge…

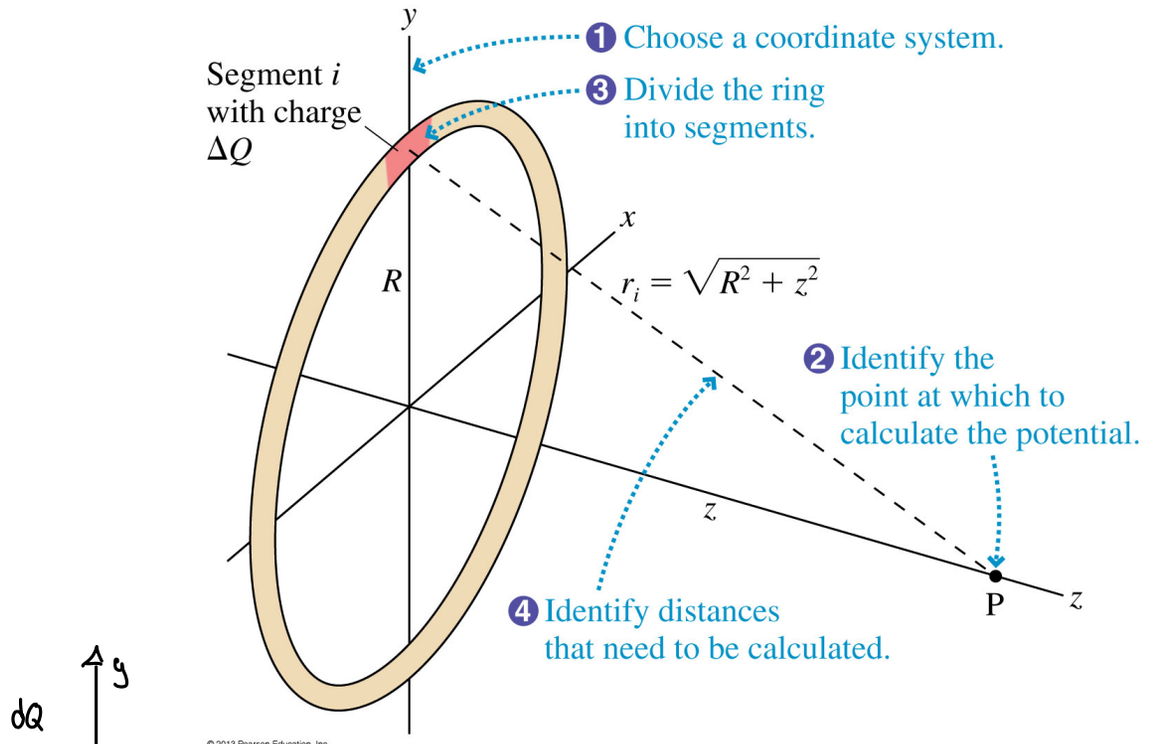
$$V = \sum_i \frac{K q_i}{r_i}$$

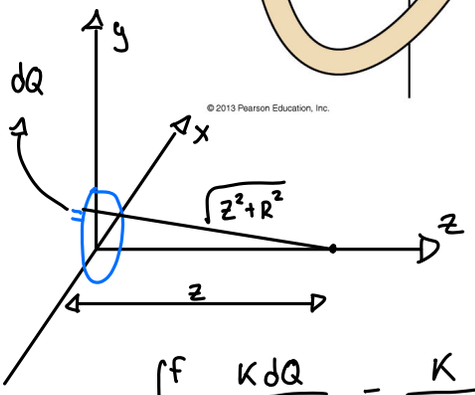
where r_i is the distance from q_i to the point in space where the potential is being calculated.

- *Electric Potentials* also obey the *Law of Superposition*!

i.e. 28.12:
The potential of a ring of charge

A thin, uniformly charged ring of radius R has total charge Q. Find the potential at distance z on the axis of the ring.





$$\int_i^f \frac{K\,dQ}{\sqrt{z^2+R^2}} = \frac{K}{\sqrt{z^2+R^2}} \int_i^f dQ$$

$$= \frac{K}{\sqrt{z^2+R^2}} \left[Q_f - Q_i \right]$$

$$= \frac{K\,\Delta Q}{\sqrt{z^2+R^2}}$$

$$V = \frac{KQ}{\sqrt{z^2+R^2}}$$

Quiz Question 3

Consider two isolated spherical conductors each having net charge Q. The spheres have radii a and b, where $b > a$. Which sphere has the higher potential?

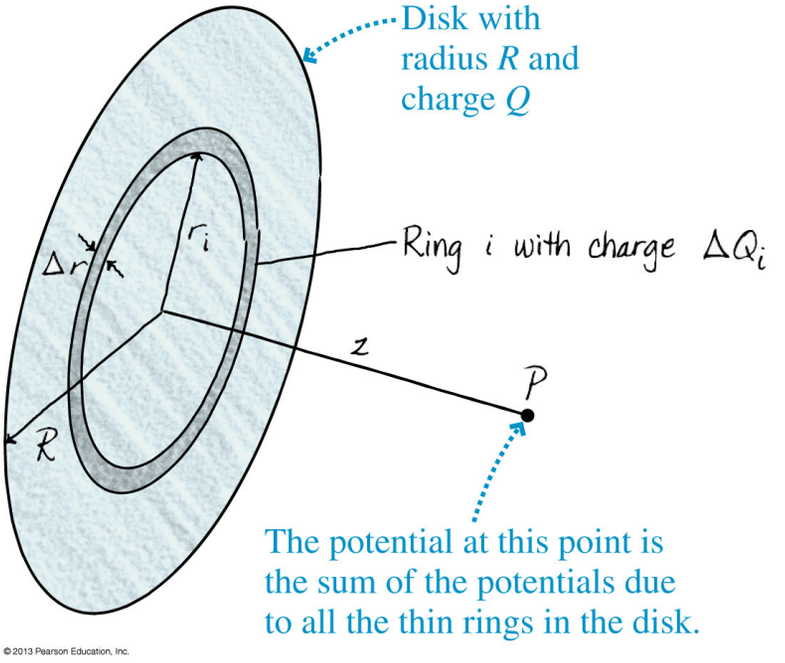
1. The sphere of radius a.
2. The sphere of radius b.
3. They have the same potential.

i.e. 28.13: The potential of a charged dime

A 17.5 mm diameter dime is charged to +5.00 nC.

a. What is the *potential* of the dime?

b. What is the *potential energy* of an electron 1.00 cm above the dime?



$$V_{Ring} = \frac{KQ}{\sqrt{z^2+R^2}} \qquad dV = \frac{K\,dQ}{\sqrt{z^2+r^2}}$$

$$\eta = \frac{Q}{A} = \frac{Q}{\pi r^2} \Rightarrow Q = \eta \pi r^2$$

$$dQ = \eta\, 2\pi r\, dr$$

$$R = \frac{0.175\,m}{2}$$

$$Q = 5.00 \times 10^{-9}\,C$$

$$dV = \frac{K\eta 2\pi r\, dr}{\sqrt{z^2+r^2}}$$

$$\int_0^R \frac{K\eta 2\pi r\, dr}{\sqrt{z^2+r^2}}$$

$$u = r^2+z^2 \qquad du = 2r\,dr \qquad \tfrac{1}{2}du = r\,dr$$

$$2\pi K\eta \int_0^R \frac{r\,dr}{\sqrt{r^2+z^2}}$$

$$2\pi K\eta \int_{z^2}^{R^2+z^2} u^{-1/2} = 2\pi K\eta\left[\sqrt{R^2+z^2} - z\right]$$